

APPENDIX 7-53
SUMMARY OF NEW ISOTOPIC INFORMATION
FOR LBA 11

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Genwal Resources, Inc., Huntington, Utah

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Mayo and Associates, LC
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Genwal Resources, Inc., Huntington, Utah

07 November 1997

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SUMMARY OF NEW ISOTOPIC INFORMATION FOR LBA 11

INTRODUCTION

As part of the collection of baseline information for LBA 11, Genwal Resources, Inc. is currently conducting an extensive water isotopic data collection program. Samples have been collected from springs and streams within LBA 11 and the existing Genwal lease area, and from groundwaters within the existing Crandall Canyon Mine. These samples have been analyzed for stable $\delta^2\text{H}$ and $\delta^{18}\text{O}$ compositions, and for unstable ^3H (tritium) and ^{14}C compositions. The locations of these samples are shown in Figure 1. The solute chemistries are represented as Stiff diagrams on Figure 1. The results of the isotopic analyses are presented in Table 1. The computed mean residence times are given in Table 2. The stable $\delta^2\text{H}$ and $\delta^{18}\text{O}$ compositions are plotted in Figure 2. The purpose of this document is to convey the preliminary findings of this ongoing investigation to date.

Since Mayo and Associates released its report *Supplemental Hydrogeologic Information for LBA 11* (18 March 1997) Genwal has installed five new wells inside the Crandall Canyon Mine. Each of the wells are constructed with 1.25 inch I.D. PVC pipe, and are plugged with bentonite and sealed to the surface with cement. Two of these new wells, MW-6A and MW-8, are completed in the Spring Canyon Member of the Star Point Sandstone. Well MW-6 is completed in the Panther Member of the Star Point Sandstone. Well UDH 46-97 was drilled upward into the Blackhawk Formation above the coal seam. Well MW-7 is completed approximately 200 feet from the Joes Valley Fault system in the Spring Canyon Member of the Star Point Sandstone. Additionally, a sample of groundwater was collected from new mine workings which encountered the Joes Valley Fault system in 5th West (5th West fault). The results of the isotopic analyses for these locations are discussed below.

RESULTS

Spring Canyon Sandstone

MW-6A

MW-6A was drilled to a depth of approximately 105 feet to the Spring Canyon Sandstone Member of the Star Point Sandstone just north of an east-west trending igneous dike. The

water from MW-6 is of the Ca^{2+} - Mg^{2+} - HCO_3^- chemical type which is similar to most other waters within the mine. The ^{14}C content of MW-6A is 8.75 pmc (percent modern carbon), which, when modeled using Pearsons, Mooks, and Fontes models, yields a mean groundwater residence time of between 14,500 and 15,400 years. The tritium (^3H) content of the water (0.20 TU) is near the laboratory detection limit. The stable isotopic $\delta^2\text{H}$ and $\delta^{18}\text{O}$ composition of this water ($\delta^2\text{H} = -130\text{‰}$, $\delta^{18}\text{O} = -17.4\text{‰}$) is similar to that of the other in-mine groundwater samples.

MW-8

MW-8 was drilled to a depth of approximately 105 feet to the Spring Canyon Member of the Star Point Sandstone just south of the igneous dike. The water from MW-8 is also of the Ca^{2+} - Mg^{2+} - HCO_3^- chemical type. Groundwater from MW-8 has a significantly greater residence time than does MW-6A. The ^{14}C content of 4.90 pmc yields a mean groundwater age of between 18,300 and 19,500 years. The ^3H content (0.10 TU) is near the laboratory detection limit. The stable isotopic $\delta^2\text{H}$ and $\delta^{18}\text{O}$ composition of this water ($\delta^2\text{H} = -131\text{‰}$, $\delta^{18}\text{O} = -17.3\text{‰}$) is similar to that of the other in-mine groundwater samples.

Panther Sandstone

MW-6

A single well, MW-6, was completed in the Panther Sandstone Member of the Star Point Sandstone to a depth of 352 feet. The well is located adjacent to MW-6A near an altered mafic igneous dike. The solute chemistry of the groundwater from MW-6 is different from that of other groundwater samples from the Star Point Sandstone in the area. The laboratory analysis indicates that the water is of the Ca^{2+} - OH^- type. We believe that the areal extent of this groundwater is probably limited and that its chemical composition is related to the adjacent igneous dike. An investigation of the chemical origin of the MW-6 groundwater was completed by David Tingey Analytical Consulting (DTAC). David Tingey of DTAC has extensive experience with the chemistry and history of Igneous Dikes in the Wasatch Plateau. DTAC concluded that the unusually high pH and elevated TDS of the water are the result of serpentinization of olivine minerals in the igneous dike in a relatively inactive groundwater flow system. We agree with their findings. The ^{14}C content of the groundwater in this well (30.39 pmc) indicates a mean groundwater residence time of 6,000 to 6,900 years. The ^3H content of 0.43 TU is near the laboratory detection limit. The stable isotopic $\delta^2\text{H}$ and $\delta^{18}\text{O}$ composition of this water ($\delta^2\text{H} = -131\text{‰}$, $\delta^{18}\text{O} = -17.2\text{‰}$) is similar to that of the other in-mine groundwater samples.

Blackhawk Formation

UDH 46-97

A vertical drill hole (UDH 46-97) was drilled upward from the mine workings into the overlying Blackhawk Formation. This hole is open over its entire extent except for 4 feet of surface casing. During drilling, no water was encountered in the Cottonwood coal seam (approximately 50 feet above the Hiawatha seam). Water was encountered in the Blind Canyon seam at approximately 94 feet. The groundwater drainage from this hole is minimal. At the time of sampling, discharge was only 0.1 gpm. The groundwater discharging from

UHD 46-97 is of the Ca^{2+} - Mg^{2+} - HCO_3^- type. The measured ^{14}C content of the groundwater discharging from this drill hole (9.65 pmc) yields a mean groundwater age of between 12,300 and 13,800 years. The ^3H content was near the laboratory detection limit at 0.00 TU. The stable isotopic $\delta^2\text{H}$ and $\delta^{18}\text{O}$ composition of this water ($\delta^2\text{H} = -132\text{‰}$, $\delta^{18}\text{O} = -17.4\text{‰}$) is similar to that of the other in-mine groundwater samples.

Joes Valley Fault System

MW-7

Well MW-7 was drilled into the Spring Canyon Member of the Star Point Sandstone approximately 200 feet from the Joes Valley Fault system. The groundwater in MW-7 is of the Ca^{2+} - Mg^{2+} - HCO_3^- type. The ^{14}C composition of the groundwater from MW-7 (31.85 pmc) yields a mean groundwater residence time of between 4,200 and 5,200 years. The ^3H content of 0.01 TU is near the laboratory detection limit. This calculated groundwater age is similar to that of groundwaters taken directly from the fault system, but is much younger than that of groundwaters taken from the Spring Canyon Member away from the fault. The stable isotopic $\delta^2\text{H}$ and $\delta^{18}\text{O}$ composition of this water ($\delta^2\text{H} = -131\text{‰}$, $\delta^{18}\text{O} = -17.3\text{‰}$) is similar to that of the other in-mine groundwater samples.

5th West Fault

Recently, the mine workings in the 5th West area in the northwestern portion of the existing lease encountered the Joes Valley Fault system. Water discharging from the fault at the mining face was sampled and analyzed. The groundwater discharging from the Joes Valley Fault at this location is of the Ca^{2+} - Mg^{2+} - HCO_3^- type. A ^{14}C content of 34.99 pmc was measured which yields a mean groundwater age of between 3,200 and 4,600 years. This age is similar to that calculated for Joes Valley Fault system water encountered previously at the western end of the West Mains. The stable isotopic $\delta^2\text{H}$ and $\delta^{18}\text{O}$ composition of this water ($\delta^2\text{H} = -131\text{‰}$, $\delta^{18}\text{O} = -17.5\text{‰}$) is similar to that of the other in-mine groundwater samples. The ^3H content of this water sample is 0.95 TU.

SUMMARY

The findings of this most recent round of isotopic sampling support the conclusions of the previous report by Mayo and Associates *Supplemental Hydrogeologic Information for LBA 11* (18 March 1997).

All of the ^3H contents of groundwaters from within the mine are less than 1 TU. Groundwaters from the Blackhawk Formation and Spring Canyon Sandstone Member of the Star Point Sandstone have radiocarbon ages between about 13,000 and 20,000 years. Groundwater from a single well in the Panther Sandstone Member of the Star Point Sandstone is between 6,000 and 6,900 radiocarbon years. Groundwater in the Joes Valley Fault system has a mean radiocarbon age between about 2,000 and 5,000 years. The water discharging from Little Bear Spring is unquestionably of modern origin. Previous investigations conducted by Mayo and Associates in the Wasatch Plateau and the Book Cliffs

coal districts have shown that the overwhelming majority of springs discharge modern water. In Figure 3, mean groundwater residence times are plotted against ^3H compositions of samples collected by Mayo and Associates from springs and creeks, and from within coal mines in the Wasatch Plateau and Book Cliffs coal fields. It is readily apparent that the waters are partitioned into modern waters (most springs, creeks, and wells) which contain abundant tritium, and very old waters (mostly in-mine samples) which contain essentially no tritium. The stable $\delta^2\text{H}$ and $\delta^{18}\text{O}$ compositions of the groundwaters from within the mine cluster together in the lower portions of the plot in Figure 2. The creek samples and Little Bear Spring sample cluster together in the upper portion of the plot. This suggests dissimilar origins for the in-mine waters and the modern, near-surface waters. The groundwater from the Panther Sandstone Member of the Star Point Sandstone beneath the mine (MW-6) has a pH and a solute chemical composition which is entirely different from that which discharges from the Panther Sandstone at Little Bear Spring. Clearly, the water discharging from Little Bear Spring is not derived from the water beneath the mine near MW-6. All of this information strongly suggests that the in-mine waters are hydrologically isolated from the shallowly circulating modern waters in overlying springs and creeks. The modern groundwater discharging from Little Bear Spring is not related to the groundwater encountered in the mine and, thus, should not be impacted by future mining operations.

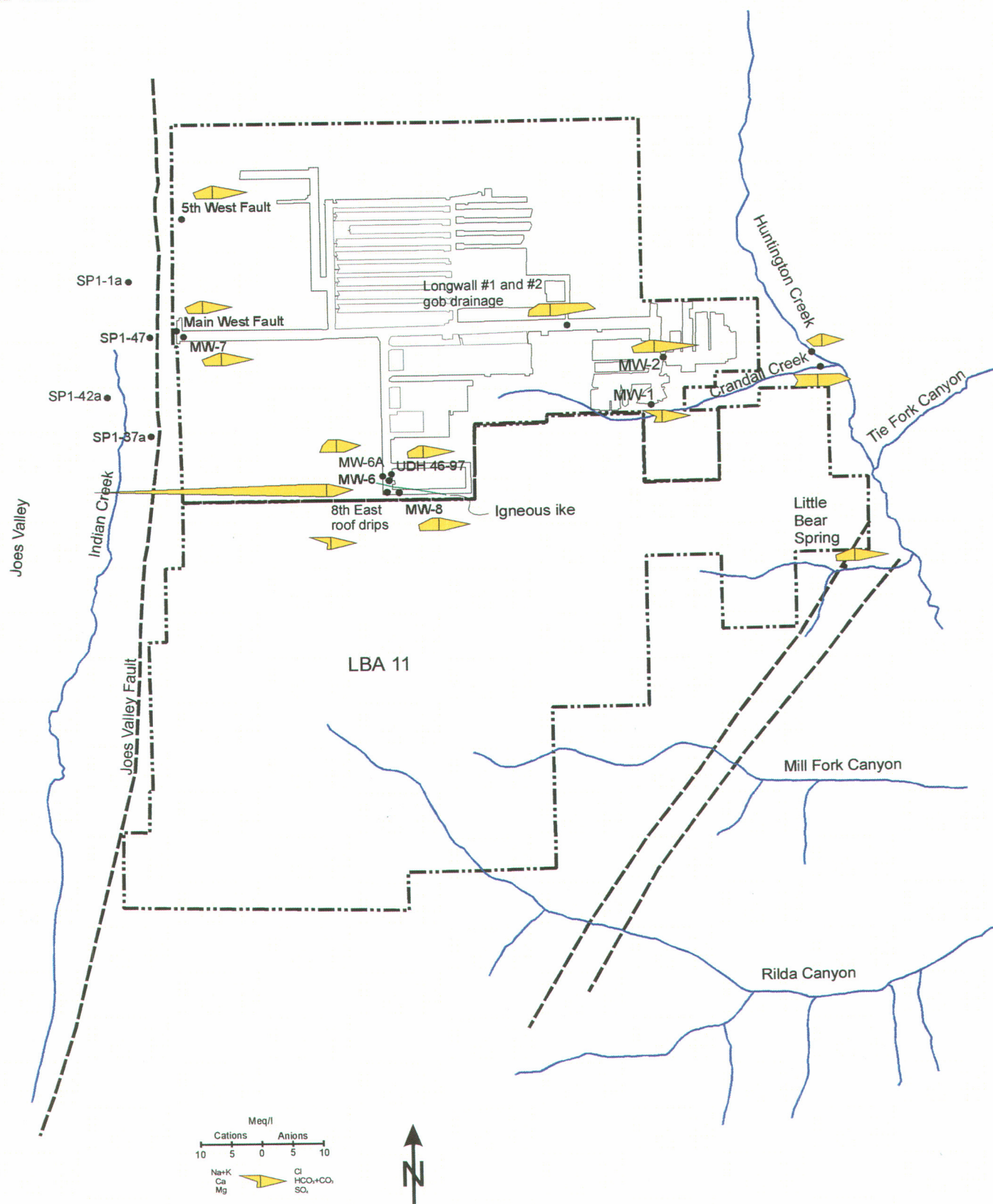


Figure 1 Location of the Genwal study area with Stiff diagrams representing solute compositions of groundwaters and surface waters.

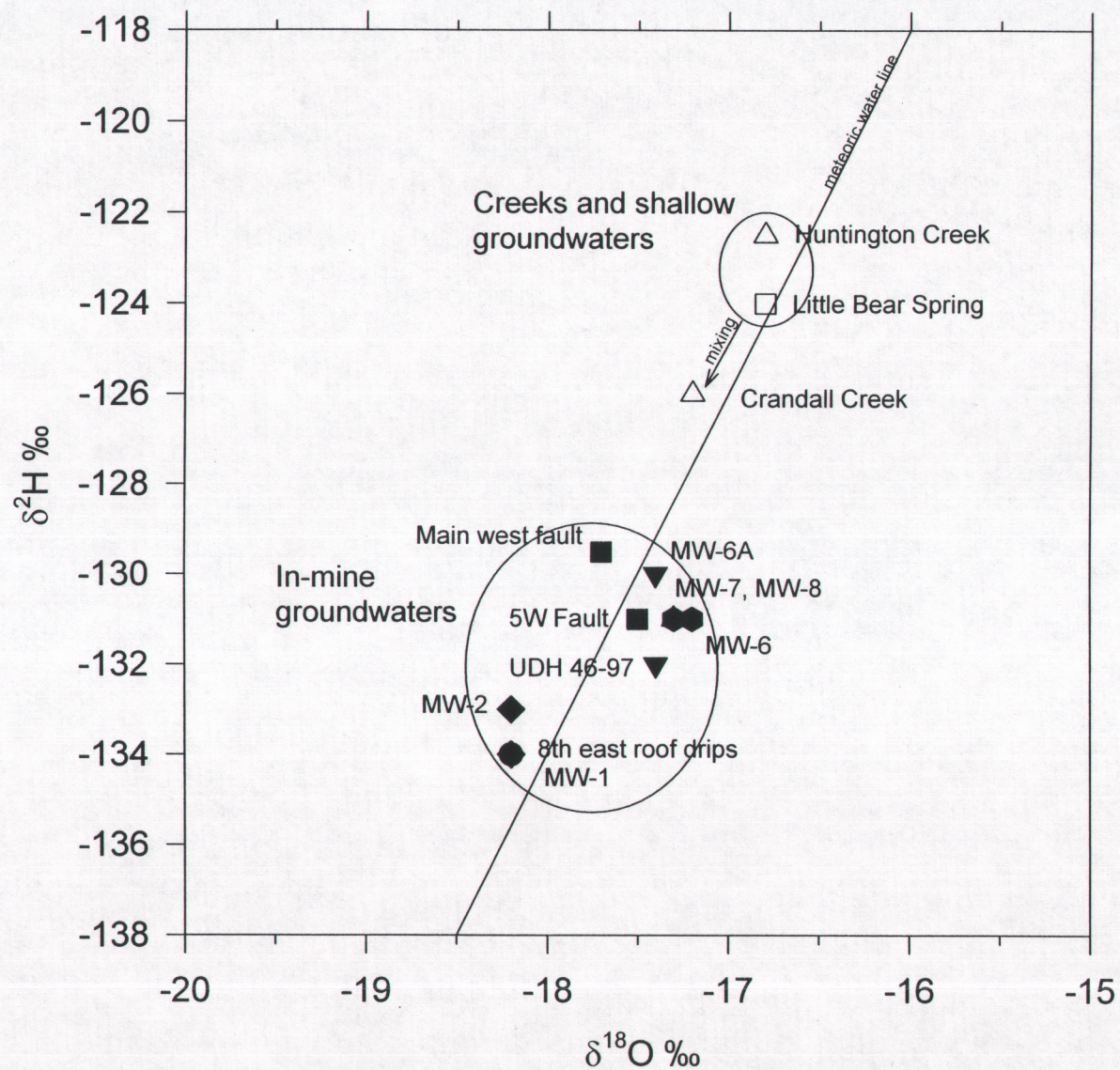


Figure 2 Deuterium and oxygen-18 plot of groundwaters and surface waters in the vicinity of the Crandall Canyon Mine.

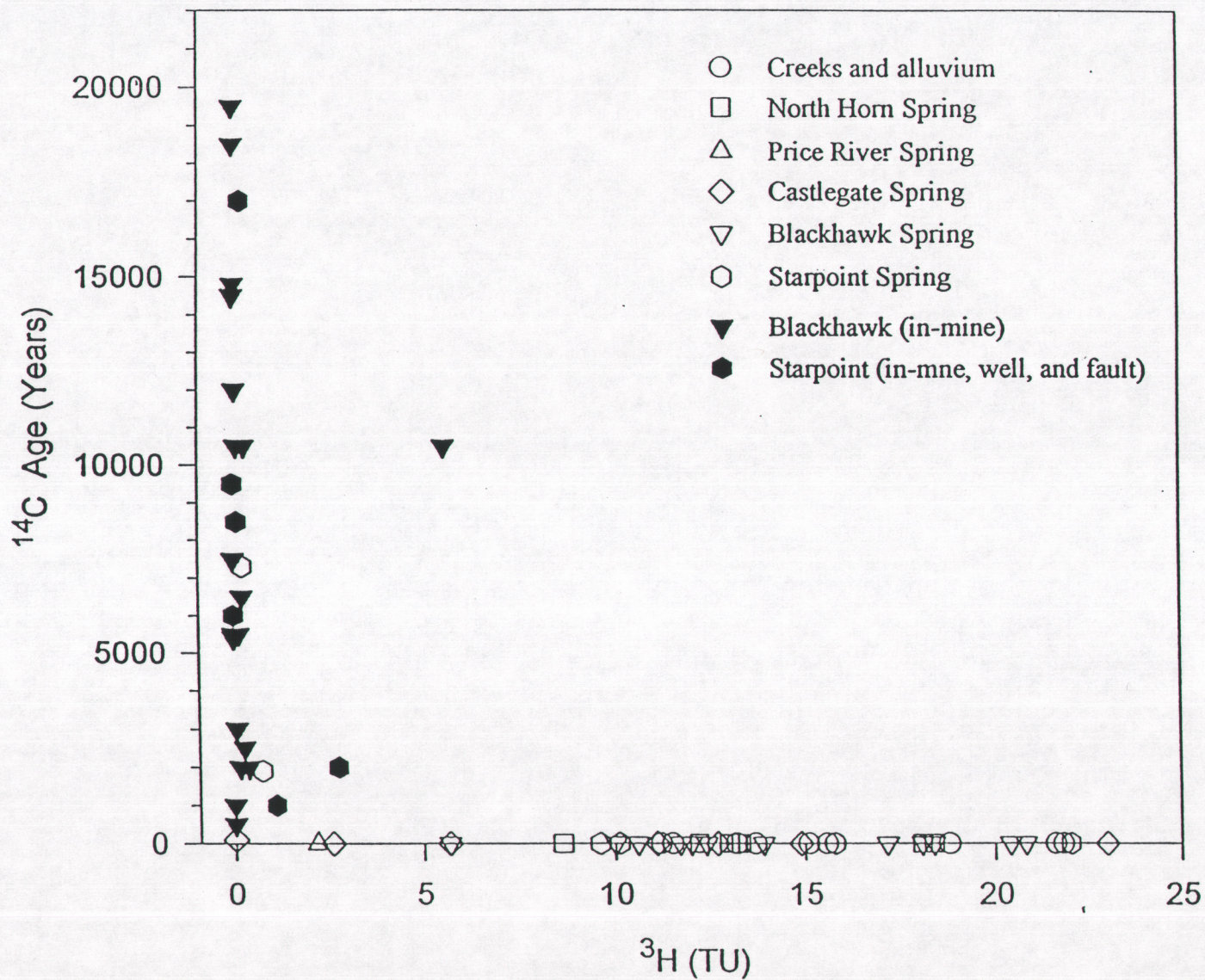


Figure 3 Mean groundwater residence time of springs, creeks, wells, and in-mine samples from the Wasatch Plateau and Book Cliffs coal districts plotted against tritium concentrations.

Table 1 Solute and isotopic composition of surface waters and groundwaters in the vicinity of the Crandall Canyon Mine.

genchem.xls 07 November 1997

| | | T | pH | Cond. | Ca ²⁺ | Mg ²⁺ | Na ⁺ | K ⁺ | HCO ₃ ⁻ | CO ₃ ⁻ | Cl ⁻ | SO ₄ ²⁻ | δ ² H | δ ¹⁸ O | δ ¹³ C | ¹⁴ C | ³ H |
|---------------------------------|-----------------------------|------|------|----------|------------------|------------------|-----------------|----------------|-------------------------------|------------------------------|-----------------|-------------------------------|------------------|-------------------|-------------------|--------------------|--------------------|
| | | °C | | umhos/cm | mg/L | | | | mg/L | | | | ‰ | | | pmc | TU |
| Springs | | | | | | | | | | | | | | | | | |
| Little Bear Spring | 10/95 and 9/96 ¹ | 8.9 | 7.6 | 556 | 62 | 37 | 7 | 1 | 341 | 0 | 7 | 29 | -124 | -16.8 | -9.7 ¹ | 71.12 ¹ | 22.00 ¹ |
| Creeks | | | | | | | | | | | | | | | | | |
| Crandall Creek | 3-Feb-97 | 2.5 | 8.6 | 1120 | 66 | 47 | 89 | 5 | 326 | 0 | 130 | 85 | -126 | -17.2 | -7.2 | 62.74 | 9.3 |
| Huntington Creek | 3-Feb-97 | 0.6 | 8.7 | 387 | 51 | 17 | 5 | 0 | 225 | 0 | 8 | 15 | -123 | -16.8 | -10.2 | 73.22 | 11.5 |
| Blackhawk Formation | | | | | | | | | | | | | | | | | |
| 8th East roof drips | 3-Feb-97 | 11.9 | 8.4 | 407 | 10 | 7 | 77 | 3 | 264 | 0 | 5 | 0 | -134 | -18.2 | -8.4 | 8.41 | 0.02 |
| UDH 46-97 | 5-Jun-97 | 10.7 | 8.1 | 504 | 50 | 29 | 15 | 4 | 316 | 0 | 5 | 26 | -132 | -17.4 | -8.5 | 9.65 | 0 |
| Joes Valley Fault system | | | | | | | | | | | | | | | | | |
| Main West fault | 3-Feb-97 | 9.3 | 7.95 | 507 | 57 | 28 | 5 | 7 | 304 | 0 | 5 | 32 | -130 | -17.7 | -10.7 | 40.07 | 0.06 |
| 5th West Fault | 5-Jun-97 | 11.1 | 8 | 520 | 62 | 32 | 3 | 2 | 346 | 0 | 6 | 67 | -131 | -17.5 | -11 | 34.99 | 0.95 |
| MW-7 | 5-Jun-97 | 12.1 | 7.7 | 511 | 62 | 32 | 4 | 2 | 319 | 0 | 10 | 33 | -131 | -17.3 | -10.8 | 31.85 | 0.01 |
| Star Point Sandstone | | | | | | | | | | | | | | | | | |
| <i>Spring Canyon Sandstone</i> | | | | | | | | | | | | | | | | | |
| MW-1 | 3-Feb-97 | 12.7 | 7.95 | 500 | 19 | 16 | 73 | 4 | 293 | 0 | 12 | 18 | -134 | -18.2 | --- | --- | --- |
| MW-2 | 3-Feb-97 | 10.9 | 7.3 | 731 | 74 | 41 | 14 | 5 | 456 | 0 | 5 | 39 | -133 | -18.2 | -11.2 | 5.79 | 0.03 |
| MW-8 | 5-Jun-97 | 14.1 | 7.8 | 547 | 64 | 37 | 17 | 6 | 317 | 0 | 8 | 40 | -131 | -17.3 | -9 | 4.9 | 0.1 |
| MW-6A | 5-Jun-97 | 14.2 | 8.2 | 544 | 46 | 32 | 22 | 12 | 243 | 0 | 17 | 61 | -130 | -17.4 | -10.1 | 8.75 | 0.2 |
| <i>Panther Sandstone</i> | | | | | | | | | | | | | | | | | |
| MW-6 | 5-Jun-97 | 13.3 | 12.6 | 6170 | 742 | 5 | 62 | 24 | 0 | 128 | 13 | 48 | -131 | -17.2 | -12.6 | 30.39 | 0.43 |

¹ Samples collected Oct. 95 and Sept. 96 by Castle Valley Special Services District



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Table 2 Calculated ^{14}C - ^3H mean groundwater residence times for the Genwal Mine area.

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| | Mean residence time (years) | | | | | | ¹⁴ C pmc | δ ¹³ C ‰ | ³ H TU |
|----------------------------------|-------------------------------------------|----------------|-----------------|-------------------------------------------|----------------|-----------------|------------------------|------------------------|----------------------|
| | δ ¹³ C = -20‰ (gas) assumption | | | δ ¹³ C = -18‰ (gas) assumption | | | | | |
| | Pearsons Model | Mooks Model | Fontes Model | Pearsons Model | Mooks Model | Fontes Model | | | |
| Creeks and springs | | | | | | | | | |
| Little Bear Spring | modern | modern | modern | modern | modern | modern | 71.12 | -9.7 | 22.00 |
| Huntington Creek | modern | modern | modern | modern | modern | modern | 73.22 | -10.2 | 11.50 |
| Crandall Creek | modern | modern | modern | modern | modern | modern | 62.74 | -7.2 | 9.30 |
| Spring SP1-1a | --- | --- | --- | --- | --- | --- | --- | --- | 29.20 |
| Spring SP1-47 | --- | --- | --- | --- | --- | --- | --- | --- | 38.20 |
| Spring SP1-37 | --- | --- | --- | --- | --- | --- | --- | --- | 33.30 |
| Spring SP1-42a | --- | --- | --- | --- | --- | --- | --- | --- | 19.20 |
| Joese Valley Fault system | | | | | | | | | |
| Main West fault | 2,400 | 2,100 | 2,100 | 3,600 | 2,100 | 2,100 | 40.07 | -10.7 | 0.06 |
| 5th West fault | 3,700 | 3,000 | 3,000 | 4,600 | 3,000 | 3,000 | 34.99 | -11.0 | 0.95 |
| MW-7 | 4,400 | 4,200 | 4,200 | 5,200 | 4,200 | 4,200 | 31.85 | -10.8 | 0.01 |
| Blackhawk Formation | | | | | | | | | |
| 8th East roof drips | 13,300 | 14,800 | 14,800 | 14,200 | 14,800 | 14,800 | 8.41 | -8.4 | 0.02 |
| UDH 46-97 | 12,300 | 13,800 | 13,800 | 13,100 | 13,800 | 13,800 | 9.65 | -8.5 | 0.00 |
| Starpoint Sandstone | | | | | | | | | |
| <i>Spring Canyon Sandstone</i> | | | | | | | | | |
| MW-2 | 18,800 | 18,800 | 18,800 | 19,600 | 18,800 | 18,800 | 5.79 | -11.2 | 0.03 |
| MW-6A | 14,500 | 14,500 | 14,500 | 15,400 | 14,500 | 14,500 | 8.75 | -10.1 | 0.20 |
| MW-8 | 18,300 | 19,500 | 19,500 | 19,200 | 19,500 | 19,500 | 4.90 | -9.0 | 0.10 |
| <i>Panther Sandstone</i> | | | | | | | | | |
| MW-6 | 6,000 | --- | --- | 6,900 | --- | --- | 30.39 | -12.6 | 0.43 |

Assumptions used in all calculations:

$\delta^{13}\text{C}$ mineral = 0‰

Activity ^{14}C gas = 100 pmc

Activity ^{14}C mineral = 0 pmc

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requested by: Erik Peterson

Date: October 23, 1997

Project: Genwal Resources Inc., water MW-6 investigation

Summary of conclusions: The chemical data reported by Commercial Testing and Engineering Co. (CTE) is reasonably accurate. Water from well MW-6 has an unusual calcium-hydroxide ($\text{Ca}^{2+}\text{-OH}^-$)-type composition, yet it is naturally occurring. This unusual composition originated from the addition of calcium oxide (CaO) and the consumption of hydrogen ion (H^+) in the water as a result of serpentinitization (alteration) of olivine minerals in an ultramafic igneous dike located approximately 300 feet south of the MW-6 wellhead. The stratigraphy below the Genwal Resources Inc., Crandall Canyon #1 Mine, Hiawatha Seam is interpreted to have contributed to the formation of this unusual water by causing a stagnant bounded water system in the Panther Sandstone that is dammed by the dike. Neither mining operations in the Crandall Canyon #1 Mine nor drilling of the MW-6 well have adversely affected the water composition.

Problem: Water sampled from well MW-6 has an unusually high pH (12.6 field). Chemical data reported by Commercial Testing and Engineering Co. Huntington office (CTE) has a cation/anion balance error of 75.7% (CTE data for MW-6 included at the end of paper). Errors over 5% are generally considered suspect and an indication of an inaccurate chemical analysis. The lab reported that the water sample has high hydroxide alkalinity which was not reported. The presence of hydroxide in high concentrations balances the cations and would correct the error balance. Is this data accurate and if so how does a natural water of this composition originate?

Methods: Field reconnaissance to determine the geologic setting and to inspect the well construction; chemical analysis of the water sample by: Atomic Absorption Spectrometry (AA), Ion Chromatography (IC), and wet chemistry titration; analysis of solid residue after evaporation of the water by: X-ray Fluorescence Spectrometry (XRF), X-ray Diffraction (XRD), and chemical tests; laboratory experiments to synthesize a water of similar composition.

Data: Well MW-6 was drilled in the floor of Genwal Resources Inc., Crandall Canyon #1 Mine. The mine is located in the Hiawatha Seam which sits on the Spring Canyon member of the Star Point Sandstone. All indications are that the well was constructed using conventional techniques with PVC pipe casing. Gary Gray's field notes document

that the well bottomed out in the Panther Sandstone member and is screened at this horizon. Above the screen horizon, conventional techniques were used to seal around the casing with bentonite pellets and concrete. The well stem is approximately 3 feet tall and had a well-purge pipe extending down the well which also capped the well. The well has been purged several times, likely displacing a volume of water sufficient to remove any contamination which might have been introduced during well construction. A second, shallower well is located approximately 10 feet east of the MW-6 well. Erik Peterson from Mayo and Associates said that analysis of water from this shallower well is normal and similar to water sampled from other wells in the area. Gary Gray indicated that the two wells were drilled at the same time using the same techniques.

Located approximately 300 feet south of the MW-6 wellhead, the Hiawatha coal seam is cut by a 3 foot wide, vertical, N80°W-striking ultramafic minette dike. Within the coal seam the dike is extremely altered to calcite and clay. The only primary mineral remaining is a trace of phlogopite (mica). The dike, which cuts the Hiawatha coal seam in the Crandall Canyon #1 mine, is part of a more extensive swarm of dikes located in the Wasatch Plateau. Several dikes in the swarm with N80°W orientations have been dated by K-Ar methods and indicate these dikes were emplaced 24 million years ago during the Miocene (Tingey and others, 1991). Fresh unaltered minette dikes are mineralogically composed of phlogopite, olivine, and pyroxene.

Chemical analysis in our laboratory of water MW-6 using standard EPA methods has shown that the analysis completed by Commercial Testing and Engineering Co., Huntington Office (CTE) is reasonably accurate (see CTE data). I measured a pH of 12.3 and determined that the water had high concentrations of calcium as the primary cation and low concentrations of the anions bicarbonate, carbonate, chloride and sulfate. Titration of the water with dilute HCl indicated that the water has a high hydroxide alkalinity as reported by CTE. Hydroxide (OH^-) with a concentration of approximately 575 mg/L would balance the cations present in water MW-6. Qualitative XRF analysis for elements heavier than atomic number 13 indicates that the residue is composed of calcium (Ca) with lesser amounts of sulfur (S), chlorine (Cl), potassium (K), phosphorous (P), and strontium (Sr). XRD analysis of the residue showed that it is composed of calcium oxide (CaO) and lesser amounts of calcite (CaCO_3).

Laboratory experiments were set up to synthesize a water of similar composition to MW-6. Measured amounts of CaO , CaCO_3 , and Portland Cement were added to three beakers of ultrapure DI water (filtered to 0.2 micron and processed through a Millipore water purification system). The amount of reagent added was calculated to give a calcium concentration similar to that measured in water MW-6. Portland cement was investigated as a possible contaminant introduced during well construction. The results of these experiments indicate that the addition of CaO produced a water chemistry similar to that of water MW-6 with a pH of 11.7 and similar chemical properties during titration. The addition of CaCO_3 , and Portland Cement produced water chemistries unlike MW-6 and can be ruled out as possible explanations for this unusual water chemistry.

Discussion and Conclusions:

The chemical data for water sample MW-6 reported by Commercial Testing and Engineering Co. (CTE) is reasonably accurate and agrees with the data collected in our laboratory. Water from the MW-6 well can best be described as naturally- occurring, having an unusual calcium-hydroxide ($\text{Ca}^{2+}\text{-OH}^-$)-type composition. Mining operations in the Crandall Canyon #1 Mine or the drilling of well MW-6 have had no impact on the water composition.

Meteoric water with unusually high pH and a calcium-hydroxide ($\text{Ca}^{2+}\text{-OH}^-$)-type composition which are associated with ultramafic rocks have been reported by Barnes and others, (1967) for several locations in California, and by Maksimovic and others, (1995) in Serbia. Waters from Red Mountain Stanislaus County, and Santa Clara County, California have a pH of 11.78 and 12.01 with calcium as the primary cation, low magnesium concentration and no detectable bicarbonate and carbonate (Barnes and others, 1967). These unusual hydroxide- balanced waters are attributed to serpentinization of olivine in ultramafic rocks which contributes CaO to the water. In the U.S. Geological Survey Water-Supply paper 2254, (Hem, 1992) the formation of these unusually-high pH waters associated with ultramafic rocks is attributed to reactions consuming H^+ at a higher rate than the influx of carbon dioxide species. Calcium oxide (CaO) released into the water disassociates in the following reaction: $\text{CaO} + \text{H}^+ \rightleftharpoons \text{Ca}^{2+} + \text{OH}^-$. As the H^+ ions are consumed the pH goes up. In order for this unusual water to be formed these conditions must also include the lack of carbon dioxide (CO_2) species being added to the system. If CO_2 is added to the system, carbonic acid forms and calcite (CaCO_3) precipitates from the water, causing the pH to drop.

The structural relationship between the vertical N80°W- striking ultramafic igneous dike, the Panther sandstone, and the low permeable shales above and below the Panther sandstone have contributed to the formation of this unusual water. The local gentle dip of the Panther sandstone towards the ultramafic dike, combined with the bounding shales, creates a stagnant water system dammed by the dike. These conditions within the Panther sandstone allowed time for this unusual water to form from the slow chemical reactions taking place as the olivine minerals within the dike serpentinized, releasing calcium oxide (CaO). Low water flow rates have also contributed by keeping an influx of carbon dioxide from entering the water system.

References:

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July 8, 1997

GENWAL RESOURCES, INC.
P.O. BOX 1420
HUNTINGTON UTAH 84528

Sample identification by
GENWAL COAL CO.

ID: MW-6

Rec'd 0900 hr.

Sampled 1605 hr.

Kind of sample Water
reported to us

Sample taken at Genwal

Sample taken by Genwal

Date sampled June 5, 1997

Date received June 6, 1997

Field Measurements

pH 12.6

DO 11.2

Conductivity 6170

Temperature 13.3°C

NOTE: Dissolved Iron filtered at lab

NOTE: Charge balance greater than 10
due to high Hydroxide Alkalinity in
sample!

Analysis report no. 59-17276

| Parameter | Result | MPL | Units | Method | Analysed Date/Time/Analyst |
|-------------------------|--------|------|---------------------------|-------------|-------------------------------|
| Alkalinity, Bicarbonate | <50 | 50 | mg/l as HCO ₃ | SM2320-B | 06-16-1997 1700 RJ |
| Alkalinity, Carbonate | 128 | 50 | mg/l as CO ₃ | SM2320-B | 06-16-1997 1700 RJ |
| Alkalinity, Total | 1405 | 50 | mg/l as CaCO ₃ | EPA 310.1 | 06-16-1997 1700 RJ |
| Anions | 5.6 | ---- | meq/l | ----- | 07-07-1997 0800 RJ |
| Calcium, Total | 742 | 5 | mg/l | EPA 215.1 | 06-27-1997 1145 MK |
| Cations | 40.7 | ---- | meq/l | ----- | 07-07-1997 0800 RJ |
| Chloride | 13 | 1 | mg/l | SM4500-Cl-B | 06-30-1997 1100 RJ |
| Conductivity | 5890 | 1 | umhos/cm | SM2510-B | 06-10-1997 1400 SW |
| Hardness, Total | 1873 | ---- | mg/l as CaCO ₃ | SM2340-B | 07-07-1997 0800 RJ |
| Iron, Total | 1.6 | 0.1 | mg/l | EPA 236.1 | 06-27-1997 0745 MK |
| Iron, Dissolved | <0.1 | 0.1 | mg/l | EPA 236.1 | 06-27-1997 0745 MK |
| Magnesium, Total | 5 | 1 | mg/l | EPA 242.1 | 06-27-1997 1215 MK |
| Manganese, Total | 0.2 | 0.1 | mg/l | EPA 243.1 | 06-27-1997 0830 MK |
| Oxygen, Dissolved | 2.0 | ---- | mg/l | EPA 360.1 | 06-06-1997 0915 MK |
| pH | 11.86 | ---- | pH units | EPA 150.1 | 06-06-1997 1000 MK |
| Potassium, Total | 24 | 1 | mg/l | EPA 258.1 | 06-27-1997 0845 MK |
| Sodium, Total | 62 | 1 | mg/l | EPA 273.1 | 06-27-1997 1030 MK |
| Solids, Total Dissolved | 1390 | 10 | mg/l | EPA 160.1 | 06-09-1997 0700 JC |
| Solids, Total Suspended | 71 | 5 | mg/l | EPA 160.2 | 06-12-1997 0700 JC |
| Sulfate | 48 | 1 | mg/l | EPA 375.4 | 06-27-1997 0830 SC |
| Cation/Anion Balance | 75.7 | ---- | % | | 07-07-1997 0800 RJ |

Post-its Fax Note 7871

| | |
|--------------------|-------------|
| To: Jean Sombarski | From: LAURA |
| Co./Dept. | Co. CTE |
| Phone # | Phone # |
| Fax # 6378860 | Fax # |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

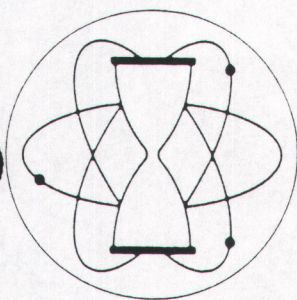
Laura Sombarski

Huntington Laboratory *LD*



OVER 40 BRANCH LABORATORIES STRATEGICALLY LOCATED IN PRINCIPAL COAL MINING AREAS, TREATMENT AND GREAT LAKE PORTS, AND REVENUE LOADING FACILITIES
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GEOCHRON LABORATORIES a division of
KRUEGER ENTERPRISES, INC.

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TELEPHONE: (617) 876-3691 TELEFAX: (617) 661-0148

RADIOCARBON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. GX-23181-PRI

Date Received: 06/23/97

Your Reference: letter of 06/17/97

Date Reported: 06/27/97

Submitted by: Mr. Erik Petersen
Mayo and Associates
710 East 100 North
Lindon, Utah 84042

Sample Name: MW-6A

AGE = 19,570 +/- 1,510 C-14 years BP (C-13 corrected).
(8.75 +/- 1.63) % of the modern (1950) C-14 activity.

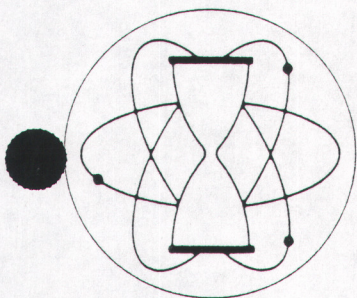
Description: Sample of groundwater precipitate.

Pretreatment: The barium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum to recover carbon dioxide from the barium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}\text{C}_{\text{PDB}} = -10.1 \text{ ‰}$

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C . The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.



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RADIOCARBON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. GX-23182-PRI

Date Received: 06/23/97

Your Reference: letter of 06/17/97

Date Reported: 06/27/97

Submitted by: Mr. Erik Petersen
Mayo and Associates
710 East 100 North
Lindon, Utah 84042

Sample Name: 5th West Fault

AGE = 8,440 +/- 270 C-14 years BP (C-13 corrected).
(34.99 +/- 1.17) % of the modern (1950) C-14 activity.

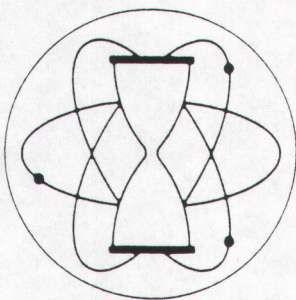
Description: Sample of groundwater precipitate.

Pretreatment: The barium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum to recover carbon dioxide from the barium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment:

$\delta^{13}\text{C}_{\text{PDB}} = -11.0 \text{ ‰}$

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C . The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.



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RADIOCARBON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. GX-23155-PRI

Date Received: 06/10/97

Your Reference: letter of 06/06/97

Date Reported: 06/17/97

Submitted by: Mr. Erik Petersen
Mayo and Associates
710 East 100 North
Lindon, Utah 84042

Sample Name: MW-8 (05 June 1997)

AGE = 24,200 +/- 3,400 C-14 years BP (C-13 corrected).
(4.90 +/- 1.67) % of the modern (1950) C-14 activity.

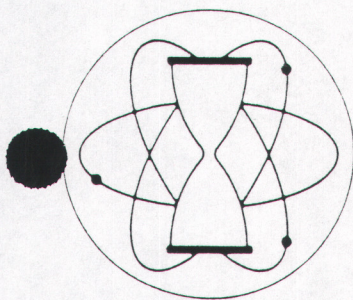
Description: Sample of groundwater precipitate.

Pretreatment: The barium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum to recover carbon dioxide from the barium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment: Small sample; approximately 0.51 grams carbon.

$\delta^{13}\text{C}_{\text{PDB}} = -9.0 \text{ ‰}$

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C . The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.



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RADIOCARBON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. GX-23157-AMS

Date Received: 06/10/97

Your Reference: telefax rec'd 06/25/97

Date Reported: 07/22/97

Submitted by: Mr. Erik Petersen
Mayo and Associates
710 East 100 North
Lindon, Utah 84042

Sample Name: MW-6

AGE = 9,570 +/- 60 C-14 years BP (C-13 corrected).
(30.39 +/- 0.20) % of the modern (1950) C-14 activity.

Description: Sample of groundwater precipitate.

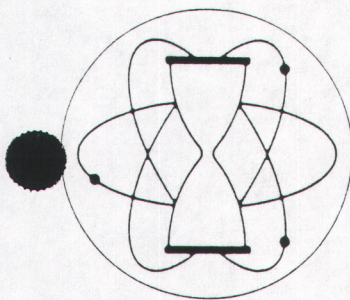
Pretreatment: The barium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum to recover carbon dioxide from the barium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

The sample was very small and analysis by accelerator mass spectrometry (AMS) was required.

Comment:

$\delta^{13}\text{C}_{\text{PDB}} = -12.6 \text{ ‰}$

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C . The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid.
The age is referenced to the year A.D. 1950.



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RADIOCARBON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. GX-23156-PRI

Date Received: 06/10/97

Your Reference: letter of 06/06/97

Date Reported: 06/17/97

Submitted by: Mr. Erik Petersen
Mayo and Associates
710 East 100 North
Lindon, Utah 84042

Sample Name: UDH 46-97 (05 June 1997)

AGE = 18,780 +/- 1,140 C-14 years BP (C-13 corrected).
(9.65 +/- 1.28) % of the modern (1950) C-14 activity.

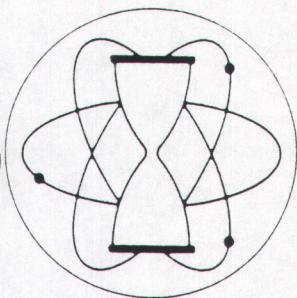
Description: Sample of groundwater precipitate.

Pretreatment: The barium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum to recover carbon dioxide from the barium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment: Small sample; approximately 0.67 grams carbon.

$\delta^{13}\text{C}_{\text{PDB}} = - 8.5 \text{ ‰}$

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C . The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.



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RADIOCARBON AGE DETERMINATION

REPORT OF ANALYTICAL WORK

Our Sample No. GX-23154-PRI

Date Received: 06/10/97

Your Reference: letter of 06/06/97

Date Reported: 06/17/97

Submitted by: Mr. Erik Petersen
Mayo and Associates
710 East 100 North
Lindon, Utah 84042

Sample Name: MW-7 (05 June 1997)

AGE = 9,190 +/- 260 C-14 years BP (C-13 corrected).
(31.85 +/- 1.02) % of the modern (1950) C-14 activity.

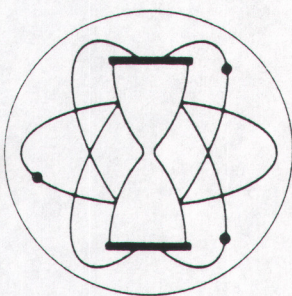
Description: Sample of groundwater precipitate.

Pretreatment: The barium salt precipitate was rapidly vacuum filtered and immediately hydrolyzed, under vacuum to recover carbon dioxide from the barium carbonates for the analysis. C-13 analysis was made on a small portion of the same evolved gas.

Comment: Relatively small sample; approximately 0.96 grams carbon.

$\delta^{13}\text{C}_{\text{PDB}} = -10.8 \text{ ‰}$

Notes: This date is based upon the Libby half life (5570 years) for ^{14}C . The error stated is $\pm 1\sigma$ as judged by the analytical data alone. Our modern standard is 95% of the activity of N.B.S. Oxalic Acid. The age is referenced to the year A.D. 1950.



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TELEPHONE: (617) 876-3691 TELEFAX: (617) 661-0148

STABLE ISOTOPE RATIO ANALYSES

REPORT OF ANALYTICAL WORK

Submitted by: Erik C. Petersen
Mayo and Associates
710 East 100 North
Lindon, UT 84042

Date Received: 06/10/97
Date Reported: 07/14/97
Your Reference: Letter of
June 6, 1997
Genwal

| Our Lab. Number | Your Sample Number | Description | δD^* | $\delta^{18}O^*$ |
|--------------------|-----------------------|-------------|--------------|------------------|
| HOR-94048 | MW-7 | Water | -131 -131 ** | -17.3 |
| HOR-94049 | MW-8 | Water | -131 | -17.3 |
| HOR-94050 | UDH 46-97 | Water | -132 -131 ** | -17.4 -17.4 ** |
| HOR-94051 | MW-6 | Water | -131 | -17.2 |

** Duplicate analyses on separate aliquots of original sample.

*Unless otherwise noted, analyses are reported in ‰ notation and are computed as follows:

$$\delta R_{\text{sample}} \text{‰} = \left[\frac{R_{\text{sample}}}{R_{\text{standard}}} - 1 \right] \times 1000$$

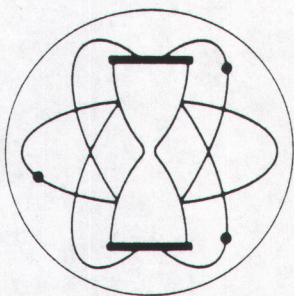
Where:

D/H standard is SMOW
 $^{18}O/^{16}O$ standard is SMOW

And:

D/H_{standard} = 0.000316**
 $^{18}O/^{16}O_{\text{standard}}$ = 0.0039948**

**Double atom ratio



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STABLE ISOTOPE RATIO ANALYSES

REPORT OF ANALYTICAL WORK

Submitted by: Erik Petersen
Mayo and Associates
710 East 100 North
Lindon, UT 84042

Date Received: 06/23/97
Date Reported: 07/14/97
Your Reference: Genwal Resources
Gary Gray

| Our Lab. Number | Your Sample Number | Description | δD^* | $\delta^{18}O^*$ |
|--------------------|-----------------------|-------------------|--------------|------------------|
| HOR-94183 | MW-6A | 5 JUNE 1997 Water | -130 | -17.4 |
| HOR-94184 | 5th West Fault | Water | -131 | -17.5 |
| | 5 JUNE 1997 | | | -17.4 ** |

** Duplicate analyses on separate aliquots of original sample.

*Unless otherwise noted, analyses are reported in ‰ notation and are computed as follows:

$$\delta R_{\text{sample}} \text{‰} = \left[\frac{R_{\text{sample}}}{R_{\text{standard}}} - 1 \right] \times 1000$$

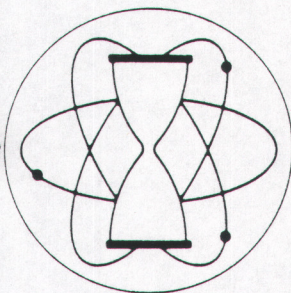
Where:

D/H standard is SMOW
 $^{18}O/^{16}O$ standard is SMOW

And:

D/H_{standard} = 0.000316**
 $^{18}O/^{16}O_{\text{standard}}$ = 0.0039948**

**Double atom ratio



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TELEPHONE: (617) 876-3691 TELEFAX: (617) 661-0148

STABLE ISOTOPE RATIO ANALYSES

REPORT OF ANALYTICAL WORK

Submitted by: Erik C. Petersen
Mayo and Associates
710 East 100 North
Lindon, UT 84042

Date Received: 06/10/97
Date Reported: 09/02/97
Your Reference: Letter of
June 6, 1997
Genwal

| Our Lab. Number | Your Sample Number | Description | $\delta^{34}\text{S}^*$ |
|--------------------|-----------------------|-------------------|-------------------------|
| SR-94052 | MW-7 | BaSO ₄ | +17.1 |
| SR-94053 | MW-8 | BaSO ₄ | +18.6 +18.7 ** |
| SR-94054 | UDH 46-97 | BaSO ₄ | +26.9 |
| SR-94055 | MW-6 | BaSO ₄ | +13.0 +9.8 *** |

** Duplicate analyses on separate aliquots of original sample.

*** Due to small amount of BaCO₃, two sample bottles of MW-6 were received and prepared on different dates. Difference in results are most likely due to inhomogeneity between the two sample bottles.

*Unless otherwise noted, analyses are reported in ‰ notation and are computed as follows:

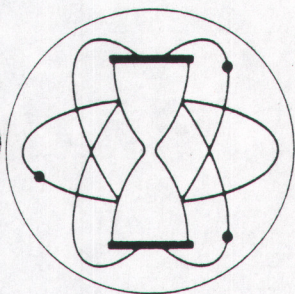
$$\delta^{34}\text{S}_{\text{sample}} \text{‰} = \left[\frac{{}^{34}\text{S}/{}^{32}\text{S}_{\text{sample}}}{{}^{34}\text{S}/{}^{32}\text{S}_{\text{standard}}} - 1 \right] \times 1000$$

Where:

${}^{34}\text{S}/{}^{32}\text{S}$ standard is Cañon Diablo troilite

And:

${}^{34}\text{S}/{}^{32}\text{S} = 0.0450045$



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TELEPHONE: (617) 876-3691 TELEFAX: (617) 661-0148

STABLE ISOTOPE RATIO ANALYSES

Submitted by: Erik Petersen
Mayo and Associates
710 East 100 North
Lindon, UT 84042

REPORT OF ANALYTICAL WORK

Date Received: 06/23/97
Date Reported: 09/02/97
Your Reference: Genwal Resources
Gary Gray

| Our Lab. Number | Your Sample Number | Description | $\delta^{34}\text{S}$ |
|--------------------|-------------------------------|-------------------|-----------------------|
| SR-94181 | MW-6A 5 JUNE 1997 | BaSO ₄ | +15.0 +15.2 ** |
| SR-94182 | 5th West Fault 5 JUNE 1997 | BaSO ₄ | +12.5 |

** Duplicate analyses on separate aliquots of original sample.

*Unless otherwise noted, analyses are reported in ‰ notation and are computed as follows:

$$\delta^{34}\text{S}_{\text{sample}} \text{‰} = \left[\frac{{}^{34}\text{S}/{}^{32}\text{S}_{\text{sample}}}{{}^{34}\text{S}/{}^{32}\text{S}_{\text{standard}}} - 1 \right] \times 1000$$

Where:

${}^{34}\text{S}/{}^{32}\text{S}$ standard is Cañon Diablo troilite

And:

${}^{34}\text{S}/{}^{32}\text{S} = 0.0450045$

Client: MAYO and ASSOCIATES - GENWAL
Recvd : 97/06/10
Job# : 960
Final : 97/07/08

Purchase Order: 97-103, 97-104
Contact: K. Payne 801/796-0211
710 E. 100 North, (F) 785-2387
Lindon, UT 84042

| Cust | LABEL INFO | JOB.SX | REFDATE | QUANT | ELYS | TU | eTU |
|-------|----------------|--------|---------|-------|------|-------|------|
| MAYO- | MW-7 | 960.01 | 970605 | 1000 | 275 | 0.01 | 0.09 |
| MAYO- | MW-8 | 960.02 | 970605 | 1000 | 275 | 0.10 | 0.09 |
| MAYO- | UDH46-97 | 960.03 | 970605 | 1000 | 275 | -0.07 | 0.09 |
| MAYO- | MW-6 | 960.04 | 970605 | 1000 | 275 | 0.43* | 0.09 |
| MAYO- | MW-6A | 960.05 | 970605 | 1000 | 275 | 0.20 | 0.09 |
| MAYO- | 5TH WEST FAULT | 960.06 | 970611 | 1000 | 275 | 1.25 | 0.09 |

* Average of duplicate runs

Client: MAYO and ASSOCIATES - GENWAL
Recvd : 97/09/11
Job# : 991
Final : 97/10/01

Purchase Order: 97-109
Contact: K. Payne 801/796-0211
710 E. 100 North, (F) 785-2387
Lindon, UT 84042

| Cust LABEL INFO | JOB.SX | REFDATE | QUANT | ELYS | TU | eTU |
|----------------------------|--------|---------|-------|------|------|------|
| MAYO-GENWAL-5TH WEST FAULT | 991.01 | 970820 | 1000 | 275 | 0.95 | 0.09 |



COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1919 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • TEL: 708-863-8300 FAX: 708-863-8308

SINCE 1888



Member of the SGS Group (Société Générale de Surveillance)

PLEASE ADDRESS ALL CORRESPONDENCE TO:
P.O. BOX 1020, HUNTINGTON, UT 84520
TEL: (801) 863-2311
FAX: (801) 863-2438

July 24, 1997

GENWAL RESOURCES, INC.
P.O. BOX 1420
HUNTINGTON UTAH 84528

Sample identification by
GENWAL COAL CO.

D: MDH-46-97

Kind of sample Water
reported to us

Rec'd 0900 hr
sampled 1530 hr

Sample taken at Genwal

Field Measurements

Sample taken by Genwal

pH 8.1
DO 12.8
Flow 0.7 gpm
Conductivity 504
Temperature 10.7°C

Date sampled June 5, 1997

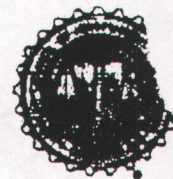
Date received June 6, 1997

NOTE: Dissolved Iron filtered at lab!

Analysis report no. 59-17279

| Parameter | Result | MRL | Units | Method | Analysed Date/Time/Analyst |
|-------------------------|--------|------|---------------------------|-------------|----------------------------|
| Alkalinity, Bicarbonate | 316 | 5 | mg/l as HCO ₃ | SM2320-B | 06-16-1997 1700 RJ |
| Alkalinity, Carbonate | 25 | 5 | mg/l as CO ₃ | SM2320-B | 06-16-1997 1700 RJ |
| Alkalinity, Total | 259 | 5 | mg/l as CaCO ₃ | EPA 310.1 | 06-16-1997 1700 RJ |
| Anions | 5.9 | ---- | meq/l | ----- | 07-07-1997 0800 RJ |
| Calcium, Total | 50 | 1 | mg/l | EPA 215.1 | 06-27-1997 1145 MK |
| Cations | 5.6 | ---- | meq/l | ----- | 07-07-1997 0800 RJ |
| Chloride | 5 | 1 | mg/l | SM4500-Cl-B | 06-30-1997 1100 RJ |
| Conductivity | 515 | 1 | umhos/cm | SM2510-B | 06-30-1997 0340 RJ |
| Hardness, Total | 244 | ---- | mg/l as CaCO ₃ | SM2340-B | 07-07-1997 0800 RJ |
| Iron, Total | 0.1 | 0.1 | mg/l | EPA 236.1 | 06-27-1997 0745 MK |
| Iron, Dissolved | 0.1 | 0.1 | mg/l | EPA 236.1 | 06-27-1997 0745 MK |
| Magnesium, Total | 29 | 1 | mg/l | EPA 242.1 | 06-27-1997 1215 MK |
| Manganese, Total | 0.2 | 0.1 | mg/l | EPA 243.1 | 06-27-1997 0830 MK |
| Oxygen, Dissolved | 6.5 | ---- | mg/l | EPA 360.1 | 06-06-1997 0915 MK |
| pH | 7.51 | ---- | pH units | EPA 150.1 | 06-06-1997 1000 MK |
| Potassium, Total | 4 | 1 | mg/l | EPA 258.1 | 06-27-1997 0845 MK |
| Sodium, Total | 15 | 1 | mg/l | EPA 273.1 | 06-27-1997 1030 MK |
| Solids, Total Dissolved | 280 | 10 | mg/l | EPA 160.1 | 06-09-1997 0700 JC |
| Solids, Total Suspended | 45 | 5 | mg/l | EPA 160.2 | 06-12-1997 0700 JC |
| Sulfate | 26 | 1 | mg/l | EPA 375.1 | 06-27-1997 0830 SC |
| Cation/Anion Balance | +2.0 | ---- | % | | 07-07-1997 0800 RJ |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO



Huntington Laboratory

OVER 40 BRANCH LABORATORIES STRATEGICALLY LOCATED IN PRINCIPAL COAL MINING AREAS, TIDEWATER AND GREAT LAKES PORTS, AND RIVER LOADING FACILITIES
Original Watermarked For Your Protection

07/08/97 TUE 13:28 FAX 8016532438

CT&E-HUNTINGTON

ANDALEX

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SINCE 1909



Member of the ASCE Group (Division of Environmental Engineering)

PLEASE ADDRESS ALL CORRESPONDENCE TO:
P.O. BOX 1000, HUNTINGTON, UT 84002
TEL: (801) 682-0000
FAX: (801) 682-0000

July 8, 1997

GENWAL RESOURCES, INC.
P O BOX 1420
HUNTINGTON UTAH 84528

Sample identification by
GENWAL COAL CO.

ID: MW-8

Kind of sample Water
reported to us

Rec'd 0900 hr.
Sampled 1410 hr.

Sample taken at Genwal

Field Measurements

Sample taken by Genwal

pH 7.8

DO 11.7

Flow 0

Date sampled June 5, 1997

Conductivity 547

Temperature 14.10C

Date received June 6, 1997

NOTE: Dissolved Iron filtered at lab

Analysis report no. 59-17278

| Parameter | Result | Unit | Units | Method | Analyst | Date/Time/Result |
|-------------------------|--------|------|----------|----------------------|-------------|---------------------|
| Alkalinity, Bicarbonate | 317 | 50 | mg/l | as HCO ₃ | SPC320-B | 06-16-1997 1700 260 |
| Alkalinity, Carbonate | <5 | 50 | mg/l | as CO ₃ | SPC320-B | 06-16-1997 1700 260 |
| Alkalinity, Total | 260 | 50 | mg/l | as CaCO ₃ | RPA 310.1 | 06-16-1997 1700 260 |
| Anions | 6.3 | --- | mg/l | --- | --- | 07-07-1997 0800 RJ |
| Calcium, Total | 64 | 5 | mg/l | --- | RPA 215.1 | 06-27-1997 1143 MK |
| Cations | 7.1 | --- | mg/l | --- | --- | 07-07-1997 0800 RJ |
| Chloride | 8 | 1 | mg/l | --- | SM4300-Cl-B | 06-30-1997 1100 RJ |
| Conductivity | 567 | 1 | umhos/cm | --- | SM2510-B | 06-30-1997 0340 RJ |
| Hardness, Total | 312 | --- | mg/l | as CaCO ₃ | SPC340-B | 07-07-1997 0800 RJ |
| Iron, Total | 3.7 | 0.1 | mg/l | --- | RPA 236.1 | 06-27-1997 0745 MK |
| Iron, Dissolved | <0.1 | 0.1 | mg/l | --- | RPA 236.1 | 06-27-1997 0745 MK |
| Magnesium, Total | 37 | 1 | mg/l | --- | RPA 242.1 | 06-27-1997 1215 MK |
| Manganese, Total | <0.1 | 0.1 | mg/l | --- | RPA 243.1 | 06-27-1997 0830 MK |
| Oxygen, Dissolved | 4.0 | --- | mg/l | --- | RPA 160.1 | 06-06-1997 0915 MK |
| pH | 7.49 | --- | pH units | --- | RPA 150.1 | 06-06-1997 1000 MK |
| Potassium, Total | 6 | 1 | mg/l | --- | RPA 258.1 | 06-27-1997 0845 MK |
| Sodium, Total | 17 | 1 | mg/l | --- | RPA 273.1 | 06-27-1997 1030 MK |
| Solids, Total Dissolved | 140 | 10 | mg/l | --- | RPA 160.1 | 06-09-1997 0700 JC |
| Solids, Total Suspended | 282 | 5 | mg/l | --- | RPA 160.2 | 06-12-1997 0700 JC |
| Sulfate | 40 | 1 | mg/l | --- | RPA 175.4 | 06-27-1997 0830 SC |
| Cation/Anion Balance | 6.6 | --- | --- | --- | --- | 07-07-1997 0800 RJ |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.



COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 1918 SOUTH HIGHLAND AVE., SUITE 210-B, LOMBARD, ILLINOIS 60148 • TEL: 708-653-0300 FAX: 708-653-9308



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P.O. BOX 1020, HUNTINGTON, UT 84028

TEL (801) 653-2311

FAX (801) 653-2436

July 24, 1997

GENWAL RESOURCES, INC.
P.O. BOX 1420
HUNTINGTON UTAH 84528

Sample identification by
GENWAL COAL CO.

ID: 5TH W FAULT

Kind of sample Water
reported to us

Rec'd 1120 hr.
Sampled 1030 hr.

Sample taken at Genwal

Field Measurements

Sample taken by Genwal

pH 8.45
DO 14.0
Flow 5 gpm
Conductivity 545
Temperature 9.20C

Date sampled June 11, 1997

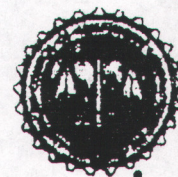
Date received June 11, 1997

NOTE: Dissolved Iron filtered at lab!

Analysis report no. 59-17304

| Parameter | Result | MRL | Units | Method | Analysed Date/Time/Analyst |
|-------------------------|--------|------|---------------------------|-------------|-------------------------------|
| Alkalinity, Bicarbonate | 397 | 5 | mg/l as HCO ₃ | SM2320-B | 06-16-1997 1700 RJ |
| Alkalinity, Carbonate | <5 | 5 | mg/l as CO ₃ | SM2320-B | 06-16-1997 1700 RJ |
| Alkalinity, Total | 326 | 5 | mg/l as CaCO ₃ | EPA 310.1 | 06-16-1997 1700 RJ |
| Anions | 7.3 | ---- | meq/l | ----- | 07-16-1997 1400 RJ |
| Calcium, Total | 74 | 1 | mg/l | EPA 215.1 | 07-11-1997 1130 MK |
| Calcious | 7.0 | ---- | meq/l | ----- | 07-16-1997 1400 RJ |
| Chloride | 6 | 1 | mg/l | SM4500-CL B | 07-02-1997 0730 RJ |
| Conductivity | 561 | 1 | umhos/cm | SM2510-B | 06-30-1997 0340 RJ |
| Hardness, Total | 337 | ---- | mg/l as CaCO ₃ | SM2340-B | 07-16-1997 1400 RJ |
| Iron, Total | 1.0 | 0.1 | mg/l | EPA 236.1 | 07-11-1997 0900 MK |
| Iron, Dissolved | 0.1 | 0.1 | mg/l | EPA 236.1 | 07-11-1997 0900 MK |
| Magnesium, Total | 37 | 1 | mg/l | EPA 242.1 | 07-11-1997 1200 MK |
| Manganese, Total | 0.1 | 0.1 | mg/l | EPA 243.1 | 07-11-1997 0930 MK |
| Oxygen, Dissolved | 6.4 | ---- | mg/l | EPA 360.1 | 06-11-1997 1520 RJ |
| pH | 7.62 | ---- | pH units | EPA 150.1 | 06-11-1997 1510 RJ |
| Potassium, Total | 2 | 1 | mg/l | EPA 258.1 | 07-11-1997 1000 MK |
| Sodium, Total | 4 | 1 | mg/l | EPA 273.1 | 07-11-1997 1030 MK |
| Solids, Total Dissolved | 340 | 10 | mg/l | EPA 160.1 | 06-12-1997 0700 JC |
| Solids, Total Suspended | 27 | 5 | mg/l | EPA 160.2 | 06-12-1997 0700 JC |
| Sulfate | 29 | 125 | mg/l | EPA 375.4 | 07-02-1997 0715 SC |
| Cation/Anion Balance | -2.2 | ---- | % | | 07-16-1997 1400 RJ |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.



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TEL: (801) 688-2871
FAX: (801) 688-2438

March 5, 1997

GENWAL RESOURCES, INC.
P.O. BOX 1420
HUNTINGTON UTAH 84528

Sample identification by
GENWAL COAL CO.

Kind of sample Water
reported to us

ID: MW-2

Sample taken at Genwal

Rec'd 1115 hr.
Sampled 1520 hr.

Sample taken by Genwal

Field Measurements
pH 7.3
DO 8.5
Conductivity 731
Temperature 10.9°C

Date sampled February 3, 1997

Date received February 4, 1997

Dissolved Iron filtered at lab

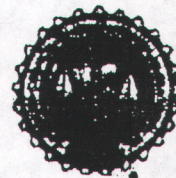
Analysis report no. 59-16962

| Parameter | Result | MRL | Units | Method | Analysed Date/Time/Analyst |
|-------------------------|--------|------|---------------------------|-------------|----------------------------|
| Alkalinity, Bicarbonate | 456 | 5 | mg/l as HCO ₃ | SM2320-B | 02-10-1997 1100 SW |
| Alkalinity, Carbonate | <5 | 5 | mg/l as CO ₃ | SM2320-B | 02-10-1997 1100 SW |
| Alkalinity, Total | 374 | 5 | mg/l as CaCO ₃ | EPA 310.1 | 02-10-1997 1100 SW |
| Anions | 8.4 | ---- | meq/l | ----- | 03-05-1997 0900 RJ |
| Calcium, Total | 109 | 1 | mg/l | EPA 215.1 | 02-12-1997 1030 MK |
| Calcium, Dissolved | 74 | 1 | mg/l | EPA 215.1 | 03-05-1997 0730 MK |
| Cations | 7.0 | ---- | meq/l | ----- | 03-05-1997 0900 RJ |
| Chloride | 5 | 1 | mg/l | SM4500-Cl-B | 02-10-1997 1030 SW |
| Conductivity | 748 | 1 | umhos/cm | SM2510-B | 02-05-1997 1230 SW |
| Hardness, Total | 354 | ---- | mg/l as CaCO ₃ | SM2340-B | 03-05-1997 0900 RJ |
| Iron, Total | 4.5 | 0.1 | mg/l | EPA 236.1 | 02-12-1997 0730 MK |
| Iron, Dissolved | <0.1 | 0.1 | mg/l | EPA 236.1 | 02-12-1997 0730 MK |
| Magnesium, Total | 60 | 1 | mg/l | EPA 242.1 | 02-12-1997 1100 MK |
| Magnesium, Dissolved | 42 | 1 | mg/l | EPA 242.1 | 03-05-1997 0745 MK |
| Manganese, Total | <0.1 | 0.1 | mg/l | EPA 243.1 | 02-12-1997 0800 MK |
| pH | 7.29 | ---- | pH units | EPA 150.1 | 02-04-1997 1245 MK |
| Potassium, Total | 5 | 1 | mg/l | EPA 258.1 | 02-12-1997 0830 MK |
| Sodium, Total | 14 | 1 | mg/l | EPA 273.1 | 02-12-1997 0900 MK |
| Solids, Total Dissolved | 413 | 10 | mg/l | EPA 160.1 | 02-06-1997 0700 JC |
| Solids, Total Suspended | 136 | 5 | mg/l | EPA 160.2 | 02-06-1997 0700 JC |
| Sulfate | 39 | 50 | mg/l | EPA 375.4 | 02-24-1997 0900 SW |
| Cation/Anion Balance | -3.8 | ---- | % | | 03-05-1997 0900 RJ |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Larry Stout

Huntington Laboratory 20



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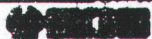
001



COMMERCIAL TESTING & ENGINEERING CO.

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 TEL: (801) 637-8861
 FAX: (801) 637-8888

July 8, 1997

 GENVAL RESOURCES, INC.
 P.O. BOX 1428
 HUNTINGTON UTAH 84528

 Sample identification by
 GENVAL COAL CO.

 ID: MW-6
 Rec'd 0900 hr.
 Sampled 1605 hr

 Kind of sample Water
 reported to us

Sample taken at Genval

Sample taken by Genval

Date sampled June 5, 1997

Date received June 5, 1997

Field Measurements

pH 12.6

DO 11.2

Conductivity 6170

Temperature 13.3°C

NOTE: Dissolved Iron filtered at lab!

 NOTE: Charge balance greater than 10
 due to High Hydroxide Alkalinity in
 sample!

Analysis report no. 59-17276

| PARAMETER | Result | MBL | Units | Method | Analysed Date/Time/Analyst |
|-------------------------|--------|-----|----------------------------|-------------|-------------------------------|
| Alkalinity, Bicarbonate | <50 | 50 | mg/l as HCO_3^- | SM2320-B | 06-16-1997 1700 RJ |
| Alkalinity, Carbonate | 128 | 50 | mg/l as CO_3^{2-} | SM2320-B | 06-16-1997 1700 RJ |
| Alkalinity, Total | 1405 | 50 | mg/l as CaCO_3 | EPA 310.1 | 06-16-1997 1700 RJ |
| Anions | 5.6 | --- | meq/l | --- | 07-07-1997 0800 RJ |
| Calcium, Total | 742 | 5 | mg/l | EPA 215.1 | 06-27-1997 1145 MK |
| Cations | 40.7 | --- | meq/l | --- | 07-07-1997 0800 RJ |
| Chloride | 13 | 1 | mg/l | SM4500-Cl-B | 06-30-1997 1100 RJ |
| Conductivity | 5890 | 1 | umhos/cm | SM2310-B | 06-10-1997 1400 SW |
| Hardness, Total | 1873 | --- | mg/l as CaCO_3 | SM2340-B | 07-07-1997 0800 RJ |
| Iron, Total | 1.6 | 0.1 | mg/l | EPA 236.1 | 06-27-1997 0745 MK |
| Iron, Dissolved | <0.1 | 0.1 | mg/l | EPA 236.1 | 06-27-1997 0745 MK |
| Magnesium, Total | 5 | 1 | mg/l | EPA 242.1 | 06-27-1997 1215 MK |
| Manganese, Total | 0.2 | 0.1 | mg/l | EPA 243.1 | 06-27-1997 0810 MK |
| Oxygen, Dissolved | 2.0 | --- | mg/l | EPA 360.1 | 05-06-1997 0915 MK |
| pH | 11.06 | --- | pH units | EPA 150.1 | 06-08-1997 1000 MK |
| Potassium, Total | 24 | 1 | mg/l | EPA 258.1 | 06-27-1997 0845 MK |
| Sodium, Total | 62 | 1 | mg/l | EPA 273.1 | 06-27-1997 1030 MK |
| Solids, Total Dissolved | 1390 | 10 | mg/l | EPA 160.1 | 06-09-1997 0700 JC |
| Solids, Total Suspended | 71 | 5 | mg/l | EPA 160.2 | 06-12-1997 0700 JC |
| Sulfate | 48 | 1 | mg/l | EPA 375.4 | 06-27-1997 0830 SC |
| Cation/Anion Balance | 75.7 | --- | % | --- | 07-07-1997 0800 RJ |

| | | | |
|-------------------|----------------|---------|--------|
| Post-Box Fax Name | 7871 | Date | 7-8-97 |
| To | Jean Sankowski | From | LAURA |
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 FAX: (801) 555-0011

July 8, 1997

 GENERAL RESOURCES, INC.
 P.O. BOX 1420
 HUNTINGTON UTAH 84528

 Sample Identification by
 GENERAL COAL CO.

ID: MW-7

 Rec'd 0900 hr.
 Sampled 1315 hr.

 Kind of sample Water
 reported to us

sample taken at Genwal

sample taken by Genwal

Date sampled June 5, 1997

Date received June 6, 1997

 Field Measurements
 pH 7.7
 DO 14.0
 Flow 0.2 gpm
 Conductivity 511
 Temperature 12.1°C

NOTE: Dissolved Iron filtered at lab!

Analysis report no. 59-17277

| Parameter | Result | REL | Units | Method | Analyst | Date/Time/Analyst |
|-------------------------|--------|-----|----------|----------------------|-----------|--------------------|
| Alkalinity, Bicarbonate | 319 | 50 | mg/l | as HCO ₃ | SM2320-B | 06-16-1997 1700 BJ |
| Alkalinity, Carbonate | <5 | 40 | mg/l | as CO ₃ | SM2320-B | 06-16-1997 1700 BJ |
| Alkalinity, Total | 262 | 50 | mg/l | as CaCO ₃ | EPA 310.1 | 06-16-1997 1700 BJ |
| Anions | 6.2 | --- | mg/l | --- | --- | 07-07-1997 0800 BJ |
| Calcium, Total | 62 | 5 | mg/l | EPA 215.1 | --- | 06-27-1997 1145 ME |
| Cations | 6.2 | --- | mg/l | --- | --- | 07-07-1997 0800 BJ |
| Chloride | 10 | 1 | mg/l | SM4800-CL-B | --- | 06-30-1997 1100 BJ |
| Conductivity | 527 | 1 | umhos/cm | SM2510-B | --- | 06-10-1997 1400 GW |
| Hardness, Total | 287 | --- | mg/l | as CaCO ₃ | SM2340-B | 07-07-1997 0800 BJ |
| Iron, Total | 0.2 | 0.1 | mg/l | EPA 236.1 | --- | 06-27-1997 0745 ME |
| Iron, Dissolved | <0.1 | 0.1 | mg/l | EPA 236.1 | --- | 06-27-1997 0745 ME |
| Magnesium, Total | 32 | 1 | mg/l | EPA 242.1 | --- | 06-27-1997 1215 ME |
| Manganese, Total | <0.1 | 0.1 | mg/l | EPA 243.1 | --- | 06-27-1997 0830 ME |
| Oxygen, Dissolved | 7.0 | --- | mg/l | EPA 360.1 | --- | 06-06-1997 0915 ME |
| pH | 7.16 | --- | pH units | EPA 150.1 | --- | 06-06-1997 1000 ME |
| Potassium, Total | 2 | 1 | mg/l | EPA 258.1 | --- | 06-27-1997 0845 ME |
| Sodium, Total | 4 | 1 | mg/l | EPA 273.1 | --- | 06-27-1997 1030 ME |
| Solids, Total Dissolved | 310 | 10 | mg/l | EPA 160.1 | --- | 06-09-1997 0700 JC |
| Solids, Total Suspended | <5 | 5 | mg/l | EPA 160.2 | --- | 06-13-1997 0700 JC |
| Sulfate | 33 | 1 | mg/l | EPA 375.4 | --- | 06-27-1997 0830 SC |
| Cation/Anion Balance | 2.0 | --- | --- | --- | --- | 07-07-1997 0800 BJ |

 Respectfully submitted,
 COMMERCIAL TESTING & ENGINEERING CO.

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Jul. 24, 1997

CENTRAL RESOURCES, INC.

P. O. BOX 1420

HUNTINGTON UTAH 84528

Sample identification by
GENWAL COAL CO.

ID: MW-6a

Kind of sample Water
reported to us

Rec'd 1150 hr.
Sampled 1500 hr.

Sample taken at Genwal

Field Measurements

Sample taken by Genwal

| | |
|----|------|
| pH | 8.2 |
| DO | 15.2 |

Date sampled June 6, 1997

Conductivity 544

Temperature 14.2°C

Date received June 9, 1997

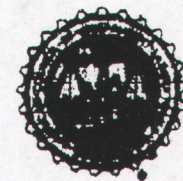
NOTE: Dissolved Iron filtered at lab!

Analysis report no. 59-17280

Analysed

| Parameter | Result | MRL | Units | Method | Date/Time/Analyst |
|-------------------------|--------|------|---------------------------|-------------|--------------------|
| Alkalinity, Bicarbonate | 243 | 5 | mg/l as HCO ₃ | SM2320-B | 06-16-1997 1700 RJ |
| Alkalinity, Carbonate | <5 | 5 | mg/l as CO ₃ | SM2320-B | 06-16-1997 1700 RJ |
| Alkalinity, Total | 199 | 5 | mg/l as CaCO ₃ | EPA 310.1 | 06-16-1997 1700 RJ |
| Anions | 5.7 | ---- | meq/l | ----- | 07-07-1997 0800 RJ |
| Calcium, Total | 46 | 1 | mg/l | EPA 215.1 | 06-27-1997 1145 MK |
| Cations | 5.7 | ---- | meq/l | ----- | 07-07-1997 0800 RJ |
| Chloride | 17 | 1 | mg/l | SM4500-Cl-B | 06-30-1997 1100 RJ |
| Conductivity | 656 | 1 | umbos/cm | SM2510-B | 06-30-1997 0340 RJ |
| Hardness, Total | 247 | ---- | mg/l as CaCO ₃ | SM2340-B | 07-07-1997 0800 RJ |
| Iron, Total | 0.8 | 0.1 | mg/l | EPA 236.1 | 06-27-1997 0745 MK |
| Iron, Dissolved | <0.1 | 0.1 | mg/l | EPA 236.1 | 06-27-1997 0745 MK |
| Magnesium, Total | 32 | 1 | mg/l | EPA 242.1 | 06-27-1997 1215 MK |
| Manganese, Total | 0.4 | 0.1 | mg/l | EPA 243.1 | 06-27-1997 0830 MK |
| pH | 7.85 | ---- | pH units | EPA 150.1 | 06-09-1997 1530 RJ |
| Potassium, Total | 12 | 1 | mg/l | EPA 258.1 | 06-27-1997 0845 MK |
| Sodium, Total | 22 | 1 | mg/l | EPA 273.1 | 06-27-1997 1030 MK |
| Solids, Total Dissolved | 320 | 10 | mg/l | EPA 160.1 | 06-09-1997 0700 JC |
| Solids, Total Suspended | 29 | 5 | mg/l | EPA 160.2 | 06-12-1997 0700 JC |
| Sulfate | 61 | 1 | mg/l | EPA 375.4 | 06-27-1997 0830 SC |
| Cation/Anion Balance | -3.9 | ---- | % | | 07-07-1997 0800 RJ |

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO



Huntington Laboratory

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